8-8-2017

PARENTAL TRANSLATION OF CHILD GESTURE HELPS THE VOCABULARY DEVELOPMENT OF BILINGUAL CHILDREN

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by

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ABSTRACT

Monolingual children identify referents uniquely in gesture before they do so with words, and parents translate these gestures into words. Children benefit from these translations, acquiring the words their parents translated earlier than the ones that are not translated. Are bilingual children as likely as monolingual children to identify referents uniquely in gesture; and, if so, do parental translations have the same positive impact on the vocabulary development of bilingual children? Our results showed that the bilingual children—dominant in English or in Spanish—were as likely as monolingual children to identify referents uniquely in gesture. More important, the unique gestures, translated into words by the parents, were as likely to enter bilingual children's speech, as it does for monolinguals—independent of language dominance. Our results suggest that parental response to child gesture plays as crucial of a role in the vocabulary development bilingual children as it does in monolinguals.

INDEX WORDS: Bilingual gesture, Monolingual gesture, Parental response, Vocabulary Development, Language learning

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A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of

Master of Arts

in the College of Arts and Sciences

Georgia State University

2017

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August 2017

DEDICATION

I would like to dedicate this work and give special thanks to my husband, Alexander, for his unwavering love, support, and the wisdom he shared with me during this process. I am also especially grateful to my loving mother, Jacqueline Gaitan, who not only made many sacrifices so that I could obtain a good education, but also through example and encouraging words taught me that accomplishments come with tenacity.

ACKNOWLEDGEMENTS

First and foremost, I would like to thank my advisor and committee chair, Dr. Şeyda Özçalışkan, for her invaluable guidance and help with this project. I also would like to thank my committee members, Dr. Rose Sevcik and Dr. Erika Hoff for their helpful suggestions along the way. I am especially grateful to Dr. Hoff and her lab for providing the data that made this project possible, and all the parents and children who took the time to participate in this study over several years. Thank you to all my wonderful research assistants Camila Cardona, Erika Alcantar Anguiano, Maria de los Angeles Ortiz, and Alessandra Gomez who worked tirelessly on the transcription and coding of the data. A special thanks goes out to my friends Samantha Emerson, Lauren Stites, Stephanie Baumann, Anita Hasni, Melinda Reed and Leslie Hodges for their feedback and support.

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1 INTRODUCTION

Young children learning only one language often display their readiness to learn a particular concept in gesture before conveying the same concept in speech (Iverson & Goldin-Meadow 2005; Özçalışkan & Goldin-Meadow 2005a). Parents respond to these gestures, often translating the gestures a child produces without speech into words. Children benefit from these translations, showing earlier mastery of the linguistic and/or cognitive skills if given the targeted instruction than if not given the instruction (Goldin-Meadow, Goodrich, Sauer, & Iverson, 2007), an effect that holds across children with different developmental profiles (Dimitrova, Özçalışkan, & Adamson, 2016). The question still remains about the factors that explain the close association between children's gestures and parent linguistic input, particularly in contexts where children are acquiring two languages simultaneously. In the proposed study, we focus on the speech and gestures produced by parent-child dyads of English-Spanish dual-language learners (hereafter bilingual children), in comparison to parent-child dyads of children learning only one language (English or Spanish); we ask whether parental response to child gesture plays the same role in helping vocabulary development in bilingual children as it does in monolingual children. Our findings will expand our understanding of key factors that contribute to language development in children growing up in bilingual environments.

1.1 Gesture and Language Development in Monolingual Children

Young children learning one language gesture frequently and these gestures precede speech (Bates, 1976; Greenfield & Smith, 1976). Around age one, gesture becomes a robust communication system that young children use to communicate (Petitto, 1992). For example, pre-linguistic monolingual children begin to produce *deictic* gestures (e.g. pointing to an object

or holding up an object) to refer to objects and people in their surroundings (Bates et al., 1979). During this time, children also begin to communicate culturally shared meanings with *conventional gestures* (e.g., moving head up and down to mean 'yes'); and approximately one year later, they begin to convey perceptual features and actions associated with objects with *iconic gestures* (e.g., interlocking thumbs and flapping hands to resemble a bird; Özçalışkan & Goldin-Meadow, 2011). During the early stages of communication, children use more gestures than words to convey meanings. For example, Iverson, Capirici, and Caselli (1994) found that, at 16-months, most children communicate mainly through gesture and rarely convey the same meaning in both speech and gesture. Similarly, Goldin-Meadow et al. (2007) observed the modality in which 10-month olds' first lexical items appeared over the course of eight observations and found that 75% of new words first emerged in gesture. Furthermore, Özçalışkan and Goldin-Meadow (2005b) found that 14-month-old children convey a greater array of meanings in gestures than in words.

Even more important, research has shown that children's early gesture production not only precedes but also predicts their subsequent language development—a pattern that becomes particularly pronounced for gestures that indicate (e.g., point at bottle) or request (e.g., extend empty palm requesting bottle) referents. For example, the more referents a child indicates with gestures at 14 months, the larger the child's subsequent vocabulary size is upon entry into preschool and elementary school (Rowe, Özçalışkan, & Goldin-Meadow, 2008; Rowe & Goldin-Meadow, 2009)—a predictive relation that remains robust across children with different developmental profiles (e.g., autism; Özçalışkan, Adamson, & Dimitrova, 2016). Also, the earlier a child points at an object, the earlier the child will produce the verbal label for that object (Iverson & Goldin-Meadow, 2005)—even in children with developmental disorders, who

produce considerably fewer gestures (Özçalışkan, Adamson, Dimitrova, & Baumann, 2017a), further highlighting the important role gesture plays during the transition from pre-linguistic to linguistic communication. As such, gestures—particularly gestures identifying referents— not only provide as a temporary medium to communicate about referents, but they also indicate that the meaning conveyed in gesture will soon appear in children's vocabularies as words across different learners.

Gesture continues to be a forerunner for upcoming changes in spoken language, even after children are fully launched into the verbal stage of communication. Children *do not* stop gesturing once they begin producing their first words. On the contrary, gesture remains an integral part of upcoming changes in language development. As children acquire language, they begin to use gesture in conjunction with words to form gesture-speech combinations, to either *complement* (e.g., child points to hat and says 'hat') or *supplement* the verbal information conveyed in speech (e.g., child points to hat and says 'give' to convey give me the hat). Importantly, the onset age of supplementary gesture-speech combinations predicts the age at which a child will produce their first two-word sentences (Goldin-Meadow & Butcher, 2003; Iverson & Goldin-Meadow, 2005). Even after the onset of two-word speech, gesture-speech combinations continue to predict increasingly complex sentence structures in speech. Özçalışkan and Goldin-Meadow (2005a, 2009) found that children, observed from child age 14 to 34 months, first produced different types of sentence constructions, including argument + argument, argument + predicate, and predicate + predicate, in gesture-speech combinations (e.g., "mommy"+ point at chair; eat + point at cookie) before producing the same constructions entirely in speech. Importantly, any delay or individual variability observed in the production of different sentence constructions in speech was preceded by a similar delay or lag in the

production of similar sentence constructions in gesture-speech combinations (Özçalışkan & Goldin-Meadow, 2010; Özçalışkan, Levine & Goldin-Meadow, 2013). Overall, these findings demonstrate that early gesture plays a key role in language development; it not only helps children express their burgeoning thoughts about words and sentences, but it might also lead the way to lexical and syntactic development.

1.2 Role of Parental Input to Child Gesture in Monolingual Children

Parents play a vital role in helping their children learn new words (Huttenlocher, Haight, Byrk, Seltzer, & Lyons 1991; Hurtado, Marchman, & Fernald, 2008). First, parents simplify their talk when speaking to their children, by pausing, slowing their speech rate, and producing shorter and less complex utterances with simpler vocabulary words (Field, 2004). In addition to modifying their speech, parents also modify their gestures. Similar to their speech, mothers of monolingual children prefer to use mostly deictic gestures rather than the relatively more complex iconic gestures in their communications with their young children (Iverson et al., 1999; Özçalışkan & Goldin-Meadow, 2005b, 2011). Finally, in addition to modifying their speech and gestures, parents observe their children's gestures and provide the spoken labels for the majority (71%) of the referents their children convey uniquely in gesture but not yet in speech (Masur 1982). Children benefit from these verbal responses parents provide to their gestures and show earlier mastery of the linguistic skills if given the targeted parental verbal response than if not given the response (Goldin-Meadow et al. 2007a). Specifically, the unique gesture referents children produce (e.g., child points to a cup) translated into words by the parent (e.g., 'Do you want the *cup*?') are more likely to enter the child's speech as words than the gesture referents that are not translated (Goldin-Meadow et al., 2007a; see also Masur, 1982)—a pattern that remains robust in children with different gesture production profiles. Importantly, parents of

children with developmental disorders (e.g., autism , Down syndrome)—regardless of differences in their children's rates of gesture production—are just as likely to provide verbal responses to their children's unique gesture referents as parents of typically developing children; and the gestures that are translated into words are more likely to appear in children's vocabularies as words than the ones that are not translated (Dimitrova et al., 2016). Maternal translations of child gesture also have a positive effect for sentence learning. Children of mothers who frequently translate their children's gestures into speech tend to produce their first two-word sentences earlier than children who do not receive such contingent verbal responses from their parents (Goldin-Meadow et al., 2007a).

Overall, these studies demonstrate that children often display their readiness to take the next step in language development through gesture, before achieving the same linguistic milestone entirely in speech. As children are in the process of learning new words, gesture positively impacts their vocabulary development not only by providing children with an alternative venue to practice communicating about referents, but also by signaling to the parent that the child's readiness to take the next step in language learning. Parental verbal response to child gesture, in turn, serves as an important scaffold for monolingual children in acquiring new vocabulary items in the spoken modality The question still remains, however, as to whether parental response plays the same role in the vocabulary development of bilingual children learning two different languages simultaneously.

1.3 Gesture and Language Development in Bilingual Children

All over the world children grow up learning or hearing two languages (Bjelland, 2009). In such bilingual contexts, children learn to speak two languages that typically use different speech sounds, vocabulary, and grammatical rules (Weiten, 2010), along with gestures that also

follow language-specific patterns (Brown, 2006). Importantly, gesture and speech remains a largely integrated system in children learning two languages, akin to their monolingual peers learning only one language. More specifically, as bilingual children's oral language abilities become increasingly more advanced in one of their languages, their gestures in that language become more complex as well, with children producing greater frequency of iconic gestures compared to relatively less complex deictic gestures in their stronger language (Mayberry & Nicoladis, 2000) For example, Nicoladis, Mayberry, and Genesee (1999) found that 2-year-old French-English bilingual children, when interacting with their parents in a free play context, produced more iconic gestures in their dominant than their weaker language—a pattern that was reversed for the production of deictic gestures. Nicoladis (2002) also replicated the results from Nicoladis et al. (1999) in a later study with an older group of French-English bilingual children (between 3;6 and 4;11 years old). In this later study, children used more conventional and deictic gestures when speaking their weaker language and more iconic gestures when speaking their stronger language, suggesting that different gesture types might be more prevalent in children's weaker vs. stronger language.

Despite several studies that focused on the amount and types of gestures bilingual children produced in their two languages, less is known how bilingual children's gesture production is related to changes in their spoken language abilities. More specifically, we do not yet know whether bilingual children's early gestures show the same pattern as monolingual children in predicting their emerging vocabularies in speech, and whether this predictive relation between gesture and speech shows variability in children's weaker versus stronger language.

1.4 Role of Parental Input to Child Gesture in Bilingual Children

Earlier work on parental input to bilingual children focused primarily on verbal input, leaving targeted parental verbal input to child gesture unexamined. The overarching finding across several such studies was that when parental verbal input is not balanced for the two languages, the child becomes more proficient (i.e., dominant) in one language, and shows weaker spoken language abilities in the other language (Wong Kwok Shing, 2006; Hoff et al., 2012), thus showing an effect of parental verbal input on child's speech in the two languages. For example, Oller and Eilers (2002) found that 5- to 10-year-old bilingual children in the United States, whose parents spoke only Spanish at home, developed larger Spanish but smaller English vocabularies than children whose parents spoke English and Spanish at similar rates. Similarly, Hammer et al. (2009) found that when Hispanic mothers in the United States, who used more English than Spanish with their 4-year-old children, children showed slower rates of Spanish vocabulary growth and lower vocabularies in Spanish. This same study also found that mothers, who continued to speak to their children in Spanish, had children who acquired Spanish vocabulary words at a faster rate than children whose mothers spoke more English than Spanish at home. Similarly, Lambert and Taylor's (1996) study of Cuban-American families showed that the mother's fluency in English and Spanish was related to their children's relative proficiencies in the two languages, as measured by ratings mothers gave on their child's school grades in each language.

At the same time, there is also evidence that parents of bilingual children might be tuning to the language level of their bilingual children by shifting the language they use at home in response to their children's changing proficiency in their second language. For example, Prevoo et al. (2011) showed that Turkish-Dutch mothers increased their use of Dutch at home in

response to their 2-year-old children's increased use of the Dutch language. Similarly, Goodz (1989) showed that mothers' word production in the second language increased in response to their bilingual children's language switching behavior. More specifically, mothers would often respond to their children's use of words in their second language by repeating them in that language (Goodz, 1989). The existing studies thus suggest close coupling between the frequency of parental input and bilingual children's emerging vocabularies in the two languages. However, there is no work that has yet examined the role parental targeted verbal input to child gesture can play in vocabulary development. The one exception was a study by Cekaite (2009), which showed that 7- to 10-year-old bilingual children strategically used deictic gestures (e.g., holding up a workbook) to solicit information from adults (e.g., saying 'good' in response to the child's gesture) when speaking their weaker language. Leaving this study aside, we do not yet know whether parents of bilingual children show similarities to parents of monolingual children in how often they respond to and translate their children's gestures into words, and if so, whether these translations will positively influence their children's subsequent vocabularies in each of their two languages.

1.5 The Present Study

In this study, we focus on the gestures produced by children acquiring two languages simultaneously (i.e., bilingual children) and parental responses to these early gestures in relation to children's vocabulary development (**1) Our first aim is to examine overall differences in unique gesture production between bilingual children learning English and Spanish simultaneously and monolingual children learning either English or Spanish.** Based on previous work that shows similar proportion of unique gesture use across monolingual children with markedly different gesture production rates (Özçalışkan et al., 2017a), we predict that

bilingual children will express a comparable proportion of referents uniquely in gesture, compared to monolingual children speaking either Spanish or English. **(2) Our second aim is to determine whether parents of bilingual children are as likely as parents of monolingual children to translate their children's gestures into words.** We predict that parents of bilingual children will produce similar proportions of translations for their children's gestures as parents of monolingual children, based on earlier work (Dimitrova et al., 2016) that showed no differences in parental response to child gesture in monolingual children with different developmental and gesture production profiles. **(3) Our third aim is to determine whether parents' verbal translations will increase the likelihood of the referents conveyed uniquely in gesture subsequently entering bilingual children's emerging spoken vocabularies as words, at rates comparable to monolingual children.** We predict that the gesture referents that parents translated will be more likely to enter bilingual children's spoken vocabularies as words than the gesture referents not translated by the parents and at proportions comparable to monolingual children, based on a pattern observed for monolingual children with different developmental trajectories (Dimitrova et al., 2016). **(4) Our fourth aim is to examine whether the aforementioned patterns would differ by language dominance.** Based on earlier work (Nicoladis, 2002) that showed greater use of deictic gestures indicating referents in children's weaker language, we predict that bilingual children will indicate a greater proportion of referents in their weaker language—be it Spanish or English. Also based on earlier work that showed no variability in parental input to child gesture across children who differed strongly in their production of unique gestures (Özçalışkan et al., 2017b), we predict no differences in the proportion of parental verbal response to child gesture in children's weaker or stronger language. Consequently, we predict that translated gestures in the dominant language will be as likely to

enter the child's subsequent vocabularies as words compared to the ones translated in the child's non-dominant language.

2 METHODS

2.1 Participants

The sample included 34 monolingual child-parent dyads (17 English, 10 boys; 17 Spanish, 9 boys), and 34 bilingual child-parent dyads (17 English dominant, 10 boys; 17 Spanish dominant, 8 boys). All monolingual children were primarily exposed to their native language at home ($M_{EXPOSURE} \geq 90\%$), as assessed by the Home Language Environment Questionnaire completed by the parent at initial observation (HLEQ; Marchmann & Martinez-Sussman, 2002). Dominance for bilingual children in English and Spanish was assessed by the McArthur Bates Communicative Development Inventory (MCDI; Fenson et al., 2007) and Inventario Del Desarollo de Habilidades Comunicativas Inventario (IDHC; Jackson-Maldonado, Bates, & Thal, 2003), respectively. Bilingual children who had larger vocabularies in one language were considered as dominant in that language (MCDI/IDHC, Dominant Language Range: 53 – 545). The sample for this study came from a larger longitudinal study on the oral language development of 232 children residing in the greater South Florida area. The 34 bilingual children were selected so that they were comparable to the 34 monolingual children in their expressive language (MCDI/IDHC; $t(59) = .52$, $p = .61$), in family SES, and gender composition; all 34 bilingual children were also dominant only in one of the their two languages. The majority of the parents in the monolingual (English: 16, Spanish: 17) and bilingual dyads (English dominant: 10, Spanish dominant: 14) were mothers. Parents in each group had similar educational backgrounds: majority of the monolingual parents (English: 34, Spanish: 32) and bilingual parents (English dominant: 34, Spanish dominant: 34) had either college (monolingual: 50%;

bilingual: 50%), or high school degrees (monolingual: 28%; bilingual: 22%). In majority of the observations, child interacted with the same parent over time (85%); in a few cases there was a switch from one parent to another (15%) in the second or third observation.

2.2 Data Collection

Children and their parents were video recorded three times, from child age 2;6 to 3;6, with 6-month intervals either in their homes or in the laboratory. During each observation, each dyad was given 3 different toys, including a toy animal set with 42 different animals, a picnic set with 38 picnic items, and picture books (*Big Red Farm, Good Night Moon, Brown Bear Brown Bear What do you See*? and their published Spanish translations). The spoken labels for items in the animal and picnic toy set represented a wide array of consonant-vowel combinations in each of the two languages. Parents were asked to play as naturally as possible with their children using each toy, resulting in an average playtime of 30 minutes per video. The same three toys were used at each visit to avoid context effects on language production. Monolingual child-parent dyads were observed once at each observation period; while bilingual child-parent dyads were observed twice at each observation period but on two different days, once with the parent who provides the English language input and once with the parent who provides the Spanish language input. Majority of the bilingual children interacted with the same parent in both the English and the Spanish language interaction (76%), while the remainder (24%) interacted with one parent for English and the other parent for Spanish language input.

In addition to the MCDI/IDHC administered at age 2;6, children's expressive vocabulary size in each language was also assessed at ages 2;6, 3;0 and 3;6, using the Expressive One Word

Picture Vocabulary Test (Brownell, 2010).[1]

2.3 Transcription and Coding

All parent-child videos were transcribed for speech using the Codes for Human Analysis Transcript (CHAT), with one utterance per line. An utterance is defined as one full grammatical sentence or part of a sentence that is separated by a pause. Sounds that are articulated words found in the dictionary, referred to entities, properties, or events (e.g. 'doll'), onomatopoeic sounds (e.g. 'meow'), and evaluative sounds (e.g. 'woops') were transcribed; other nonconventional sounds such as babbling, or noises that are not communicative (e.g. laughing or gasping) were not counted as words. We did, however, count incomplete sounds that are intelligible as words (e.g., anana for 'banana'). We further coded parent-child videos for child gesture and parental verbal response to child gesture, as outlined below.

Child gesture: All gestures produced by children at initial observation (child age 2;6) were coded. Gesture was defined as a communicative hand movement that did not directly manipulate objects (e.g., twisting a bottle open; Özçalışkan & Goldin-Meadow, 2005a). Hold-up gestures, which served the same function as pointing gestures by drawing the observer's attention to an object, were also coded as deictic gestures, following Özçalışkan & Goldin-Meadow (2005a). In this study, we focused on two types of gestures that conveyed information about objects, namely *deictic* gestures that indicated objects (i.e., pointing at or holding up a toy) and *give* gestures that requested objects (i.e., extending open palm to request a toy), following earlier work (Dimitrova et al., 2016). We excluded conventional gestures, because they did not refer to objects but instead conveyed culturally-prescribed meanings (e.g., shaking the head to

[1] To obtain Spanish expressive vocabulary scores, the original EOWPTV was administered and children were only permitted to answer in Spanish to obtain expressive vocabulary Spanish EOWPTV scores for each child.

mean no). We also excluded the few iconic gestures from the main analyses, because almost all of these gestures (76/85) conveyed only action information (e.g., wiggling fingers back and forth to convey walking; see Appendix 1 for the mean distribution of different types of gestures produced by monolingual and bilingual children).

We further coded all deictic and give gestures at initial observation as identifying either (1) a referent not yet expressed in speech (e.g., child points to a doll but does not yet produce the word 'doll' at initial observation) or (2) a referent already expressed in speech (e.g., child points to a doll and produces the word 'doll' at initial observation). In our analysis, we only focused on the gestures that identified referents the child did *not* yet label in speech, creating a 'unique gesture vocabulary' for each individual child.

Parental translation of child gesture: For parental translation, we identified each parental verbal response to each unique gesture that their child produced (e.g., point at doll) at initial observation (child age 2;6), and coded it as either *translating* (e.g., 'That is a pretty doll') or *not translating* (e.g., 'I will get it') the child's gesture into words during the same observation, following earlier work (Goldin-Meadow et al., 2007; Dimitrova et al., 2016).

Child vocabulary: We examined each child's speech production at the two subsequent observations conducted at child age 3;0 and 3;6, for the appearance of words that were initially conveyed uniquely in gesture at initial observation. These unique gesture referents children produced at initial observation were then coded as either *entering* or as *not entering* the child's spoken vocabulary as words in the two subsequent observation sessions.

Reliability: One coder coded all the gestures. An independent second coder, blind to the hypothesis of the study, coded gesture for a randomly selected 15 % of the videos for each group. Reliability was 86% (k= .86) for *detecting gesture*, 98% (k=.98) for classifying gesture

into types, 95% (*k* = .94) for *assigning meaning to gesture*, 96% (*k* = .95) *for identifying items uniquely expressed in gesture*, 92% (*k* = .85) for *parental translations of child unique gestures* and 93% (*k* = .84) for identifying *vocabulary items entering children's speech*.[2]

2.4 Data Analysis

We computed the number of unique gestures each child produced at the initial observation, and the number of verbal responses each parent produced that translated or did not translate each child's unique gesture referents at child age 2;6. We then computed the number of unique gesture referents that did or did not enter children's spoken vocabularies as words at child age 3;0 and 3;6. For the bilinguals, we tallied each of these three measures (i.e., gestures, translations and words), separately for English and Spanish. For example, if a bilingual child pointed at a cat both during both the Spanish and English language interaction without yet producing the word for it in either language, we counted it as two unique gestures. Similarly, in subsequent visits, if the same child produced the word 'cat' in English and 'gato' in Spanish interaction, we also counted these as two separate referents entering children's vocabularies as words—one in each language. Our decision to treat vocabulary items in gesture and speech separately in the two languages was based on Core et al. (Core, Rumiche, & Senor, 2013), who argues that each vocabulary item in bilingual children's repertoire—even if it refers to the same referent (e.g., cat vs. gato) involves different phonological as well as semantic representations; as such they should be treated as different types of words.

The observation time for the bilingual parent-child dyads was twice as long as the monolingual parent-child dyads (30 vs. 60 minutes); children also showed large group differences in their production of gestures as well as unique gestures (see Tables 1, 2). To

[2] Confidence Interval (CI) for the for Cohen's kappa estimate.

account for the difference in the length of the observation sessions and the variability in the production of unique gestures, we converted all raw frequencies into proportions for: (1) *child unique gesture vocabulary*, dividing the number of referents identified only in gesture by the total number of referents identified only in gesture and only in speech,[3], (2*) parent translations of child's unique gestures*, dividing the number of parent translations by the total number of child unique gestures, and (3) the translated *unique gesture referents entering child's spoken vocabulary* as words, dividing the number of translated gesture referents that emerged in children's speech by the total number of all translated gestures that did or did not enter children's vocabularies as words, separately for each parent-child dyad. We then arcsine transformed the scores, and conducted all analysis on the transformed scores.

We first analyzed group differences between all monolinguals (collapsing across English and Spanish) and all bilinguals (collapsing across Spanish dominant and English dominant bilinguals) to determine whether patterns of child unique gesture production and parental translation of such gestures at initial observation as well as the appearance of unique gesture referents as words in subsequent observations remain similar in the two groups. We analyzed group differences in children's unique gesture production and parental translations of these unique gestures, using independent t tests—with group (monolingual, bilingual) as a between subjects factor. We also examined the effect of parents' translations on the likelihood of gestured referents entering children's spoken vocabularies as words, using a two way ANOVA with translation (translated, non-translated) as within and group (monolingual, bilingual) as a between subjects factor.

[3] We excluded referents that were conveyed both in speech and in gesture in our initial observation, as we did not determine whether they first appeared in speech or in gesture in children's communicative repertoires.

We next focused only on bilinguals, and analyzed whether language dominance has any effect on the patterns of gesture and speech production, described above. We examined differences in children's production of unique gesture referents and parental translations of these unique gestures at initial observation, and appearance of gestured vocabulary items in the child's stronger vs. weaker language in the subsequent two observations, with a set of two-way mixed ANOVAs with dominance (stronger, weaker) as a within and group (English dominant, Spanish dominant) as between subjects factors.[4]

3 RESULTS

3.1 Do Parental Translations of Child Unique Gesture Facilitate the Vocabulary Development of Bilingual Children As It Does For Monolingual Children?

We first asked whether bilingual children would be as likely as monolingual children to identify referents uniquely in gesture before they did so with words. In line with our prediction, we found that bilingual children identified a similar proportion of referents uniquely in gesture as their monolingual peers (see Fig. 1A; $t(66) = .93$, $p = .36$).

We next turned to the parents and asked whether parents of bilingual children were as likely as parents of monolingual children to translate their children's unique gestures into words. As Figure 1B shows, parents of bilingual children provided a similar proportion of targeted verbal responses to their children's unique gestures as parents of monolingual children, with no group differences ($t(65) = 1.23$, $p = .22$).

[4] In the proposal, we also proposed to examine the predictive relation between unique gesture production at age 2;6 and child speech vocabulary, as measured by EOW, at age 4;0. Children's scores showed very little variability, preventing us from drawing meaningful comparisons. We therefore, decided against examining the relation between unique gesture and EOW in our analysis.

We last asked whether the unique gesture referents parents translated into speech were more likely to enter bilingual children's vocabulary as words than the ones that were not translated, and at similar rates as monolingual children. As can be seen in Fig 1C., the unique gestures translated into words by parents were more likely to enter children's spoken vocabularies as words than the ones that were not translated—a pattern that remained robust across both monolingual and bilingual children, thus showing a main effect of translation ($F(1,65) = 11.64$, $p < .01$). Of interest, our analysis also showed a main effect of group ($F(1,65) = 6.28$, $p = .01$), but no group x translation interaction ($F(1, 56) = .78$, $p = .38$)—with greater proportion of translated referents entering the vocabularies of monolingual children compared to bilingual children ($M_{MONOLINGUAL} = .50$ vs. $M_{BILINGUAL} = .34$; Bonferonni $p = .03$).

Overall these results show that bilingual children were at least as likely as monolingual children to indicate referents uniquely in gesture, and their parents were as responsive as parents of monolingual children in translating their unique gestures into words. More impressive, the translated unique gesture referents bilingual children produced were more likely to enter children's vocabularies as words over the next year, following a pattern akin to monolingual children.

3.2 Does Language Dominance Play a Role in the Effect of Parental Translation of Children's Unique Gestures?

Turning next to the effect of dominance in patterns of gesture and speech production in bilinguals, we first asked whether bilingual children were as likely to express referents uniquely in gesture in their weaker language as they do so in their stronger languages. Our analysis showed no effect of dominance ($F(1, 32) = .16$, $p = .69$), group ($F(1, 32) = .98$, $p = .33$), or

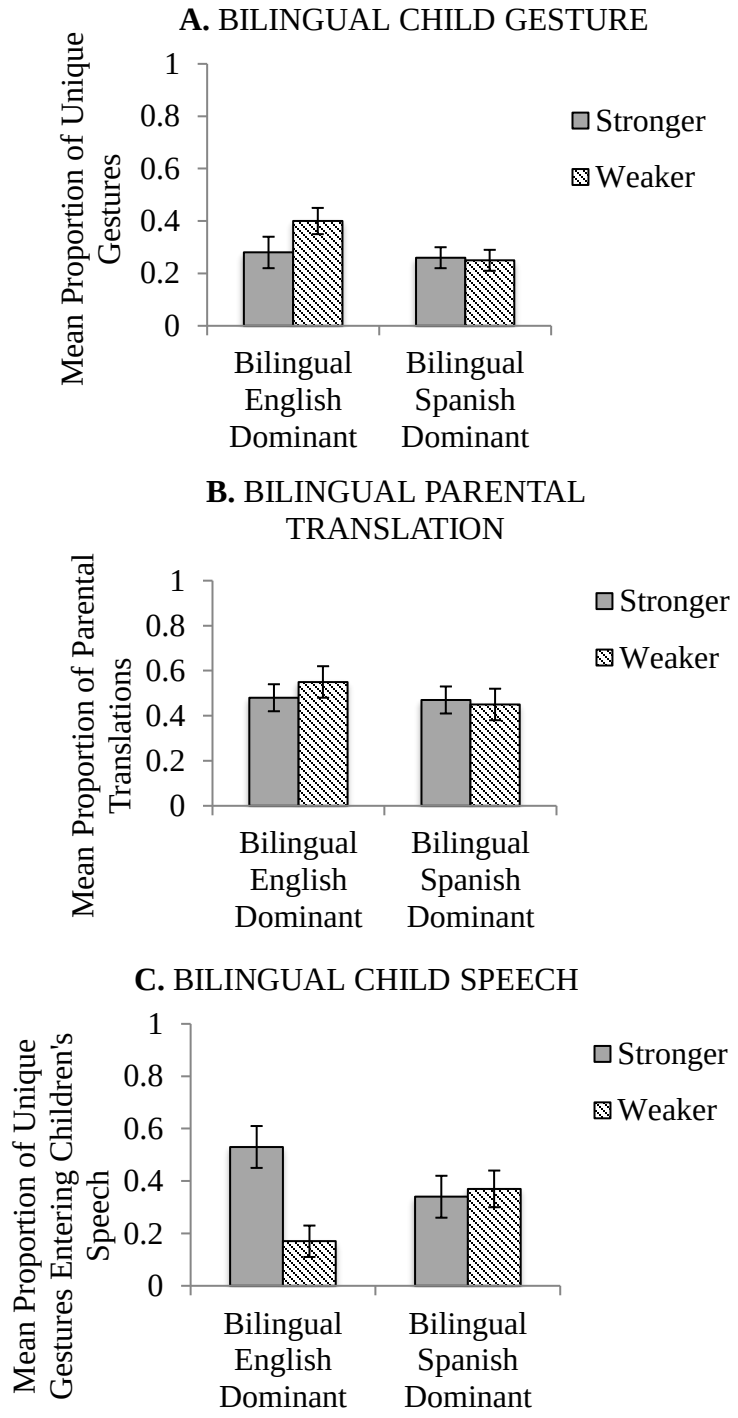

Figure 1 Mean proportion of referents bilingual children identified uniquely in gesture at 2;6 (panel A), mean proportion of unique child gestures parents of bilinguals translated into words at child age 2;6 (panel B), and mean proportion of unique gestures entering bilingual children's spoken vocabulary at child age 3;0-3;6 (panel C) for their stronger (gray) and weaker language (striped); error bars represent standard errors

dominance x group interaction ($F(1, 32) = 2.82$, $p = .10$) in children's production of unique gestures. That is, bilingual children were comparable in their production of unique gestures in their weaker and stronger languages.

We next asked whether parents' translations of bilingual children's unique gestures showed an effect of language dominance, and also found no effect of dominance ($F(1, 32) = .001$, $p = .98$), group ($F(1, 32) = .29$, $p = .60$), or dominance x group interaction ($F(1, 32) = .74$, $p = .40$), suggesting that parents were as likely to translated their children's unique gestures in their weaker as they did in their stronger language.

Turning last to the appearance of translated unique gesture referents in children's spoken repertoires as words, we found no effect of group ($F(1, 32) = .10$, $p = .76$), but a marginal effect for dominance ($F(1, 32) = 4.18$, $p = .05$), which interacted with group $F(1, 32) = 6.21$, $p = .02$). A significantly greater proportion of unique gestures entered the spoken vocabularies of bilingual English-dominant children in their stronger language than in their weaker language (Bonferroni, $p < .01$). The proportion of unique gesture referents entering children's vocabularies as words was similar for the dominant and the weaker language for bilingual Spanish-dominant children (Bonferroni, $p = .75$).

Overall, these results suggest that bilingual children were equally likely to indicate objects uniquely in gesture in their stronger and weaker languages. Furthermore, parents were just as likely to translate children's unique gesture referents in bilingual children's stronger and weaker languages. While, the English dominant bilinguals were more likely to acquire words in their stronger language than their weaker language, we found no difference for Spanish dominant bilinguals who were equally likely to acquire words in their stronger and weaker language.

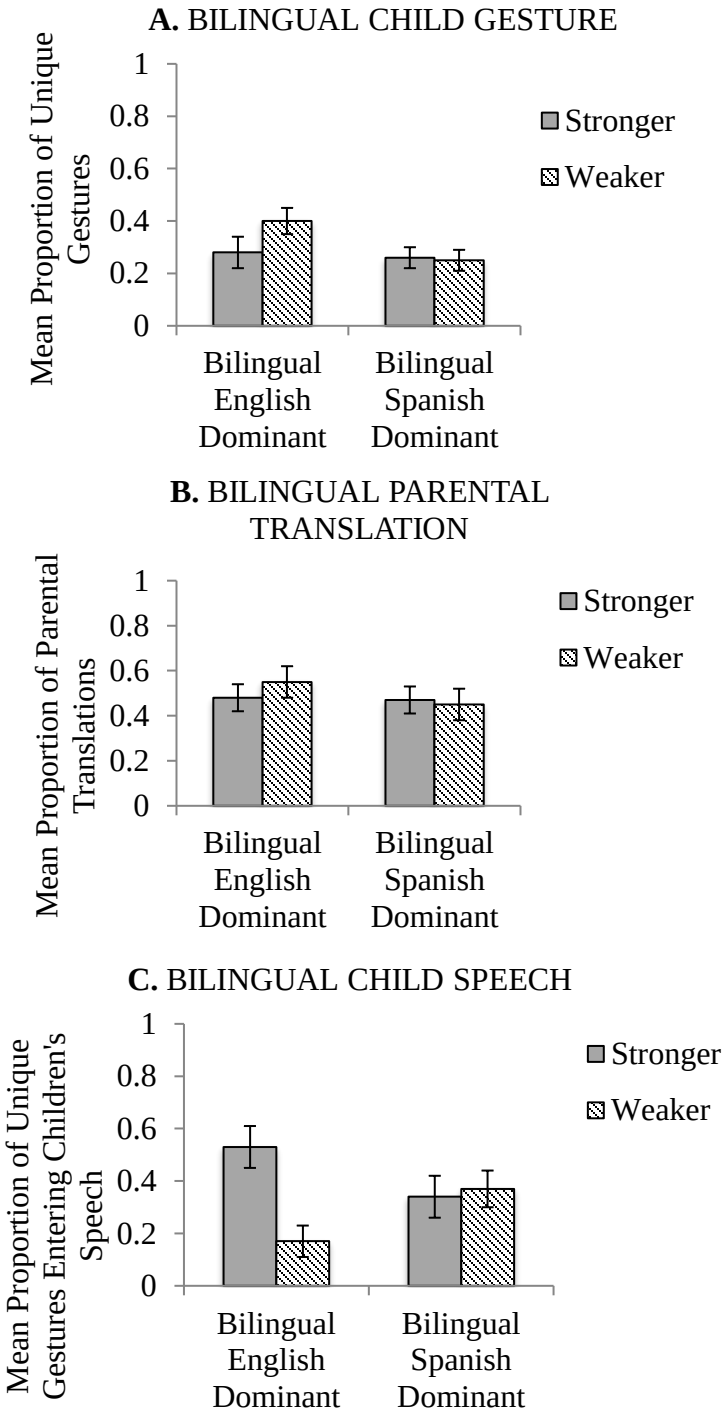

Figure 2 Mean proportion of referents bilingual children identified uniquely in gesture at 2;6 (panel A), mean proportion of unique child gestures parents of bilinguals translated into words at child age 2;6 (panel B), and mean proportion of unique gestures entering bilingual children's

spoken vocabulary at child age 3;0-3;6 (panel C) for their stronger (gray) and weaker language (striped); error bars represent standard errors

4 Discussion

In this study, we asked whether parents of bilingual children were as likely as parents of monolingual children to translate their children's unique gesture referents into words and *whether* such translations would scaffold the vocabulary development of bilingual and monolingual children alike. First, we found that bilingual children were as likely as monolingual children to indicate referents uniquely in gesture before they did so with words. Furthermore, parents in both groups paid close attention to these unique gestures and responded to them by providing the spoken label for their children's gesture referents – with parents of bilingual children providing similar proportion of translations as parents of monolingual children. Even more importantly, we found that these gesture referents that were translated into words by the parents were more likely to appear in children's vocabularies as words than the referents that were not translated, showing the important role parental verbal input plays in fostering the acquisition of new vocabulary words for bilingual children.

We first explored the unique gestures produced by 34 monolingual children and 34 bilingual children. The bilingual children in our study were just as likely as their monolingual peers to indicate or request items uniquely with *deictic* (e.g., holding up a ball or pointing at a doll) and *give* (e.g., extending an open palm to request a doll) gestures before they did so in speech with words. What might be the underlying reason for this similarity? One possible explanation could that the differences in unique gesture production are driven by differences in vocabulary. In fact, bilingual children were similar to the monolingual children in their total expressive vocabulary size at age 2;6 (MCDI/IDHC; $t(59) = .52$, $p = .61$). Given that the bilingual

children in our study knew as many words across their two languages as the monolingual children knew in one language, they were as likely as their monolingual peers to gesture about objects for which they did not yet have spoken labels for.

Importantly and for the first time, we showed that parents in both groups were equally likely to respond to their children's gestures by translating them into words —further extending the patterns found in earlier work with monolinguals to bilinguals (Dimitrova et al., 2016). This finding supports work showing that parental input to bilingual children does not differ from the input provided to monolingual children (De Houwer, 2009). In a subsequent analysis we found the amount of parental translations strongly correlated with the amount of unique gestures children produced ($r^2 = .88$, $p < .01$). Since the bilingual children indicated a similar proportion of objects uniquely in gesture as monolinguals, their parents had an equal opportunity to respond to these gestures, resulting in a comparable proportion of translations between parents of both groups. We note that in prior work with younger monolinguals (18 months), parents tended to translate a larger proportion (74%) of unique gestures into speech than the parents in our study. It is very likely that since the children in our study were older, and consequently more verbal, parental responsiveness might have been more varied, resulting in fewer translations of children's gestures than in prior work with children who primarily communicated in the gestural modality.

Turning to the most important finding of our study, we found evidence for the first time that parental translations of child gesture had positive effects on bilingual children's vocabulary acquisition – similar to those seen in monolinguals. We found this robust effect despite the parents in our study having translated a smaller proportion of gestures into speech compared to prior studies. Furthermore, previous work (Goldin-Meadow et al., 2007; Dimitrova et al., 2016)

with slightly younger children (10 —18 months old), showed that the gesture referents parents translated into words were more likely to emerge in monolingual children's speech shortly after, than those gesture referents that were not translated into words. Our findings not only add to this finding by providing evidence that parental translations lead to the earlier acquisition of new words in bilingual children, but also show that translation of child gesture remains vital for vocabulary development at an even later age (i.e., age 2;6), when children are past the two-word stage.

But why do parental translations enhance vocabulary development across different learners? As shown in earlier work (see Goldin-Meadow, 2014 for a review) children who are ready to learn a new concept use gesture to convey information that is different from their speech (i.e., gesture-speech mismatch) —akin to the unique gestures produced by the children in our study. Children who show this readiness in gesture are, in turn, more likely to learn and express the new concept in speech than children who did not show this readiness in gesture when provided with the targeted instruction on the concept. These gestures signal to the adult that a child has a wavering stance with respect to a concept and needs the adult's help to fully grasp it. Parents often respond to these gestures by modeling how to express a particular idea in speech, helping children learn the words necessary to express particular concepts in their language (Church & Goldin-Meadow, 1986; see Goldin-Meadow, 2014; Özçalışkan & Hodges, 2016 for reviews). As with monolinguals, parental translations of children's gestures in our study might be providing this critical instruction to help bilingual children who are ready to transition certain concepts from gesture to speech. In turn, bilingual children benefit from this verbal input – going on to acquire new vocabulary words. This is consistent with findings from bilingual research on parent-child communication showing that children learning two languages are as likely to benefit

from parent input as children learning one language in speech (Petitto et al., 2003). This study extends these earlier findings on speech, showing that bilinguals, like monolinguals, benefit from another facet of parent-child communication, namely parental translation of child gesture.

Why did the bilingual child acquire lower proportion of the translated gesture referents than monolingual children? Our results by no means suggest that bilingual children lag behind their monolingual peers in word learning (Hoff et al., 2012). In fact, by age 3;6 vocabulary size was comparable between the two groups (MCDI/IDHC: $t(63) = .19$, $p = .85$). Perhaps why the bilingual children tended to produce a smaller proportion of translated gesture referents in speech than monolinguals depends on their likelihood of producing translation equivalents (i.e., 'cat' vs. 'gato'). Research on similarly aged children learning English and Spanish shows that bilingual children tend to produce only a small proportion of translation equivalents in speech (21% – 30%; Mancilla-Martinez, 2011; Pearson et al., 1993). It is likely, for example, that if a child indicated a cat uniquely in gesture when speaking Spanish and it was translated by the parent into 'gato' they might have acquired 'gato' but were not likely to say it because they choose to say 'cat'. If a good proportion of the unique gesture referents that parents of bilingual children translated into speech were translation equivalents, in theory, this could drive the differences in the proportion of acquired translated gesture referents between both groups. Future work is needed to determine whether parental translations of child gesture are most beneficial for items bilingual children do not know the word for in either language.

4.1 The Effect of Language Dominance on the Effect of Parental Translation

Turning exclusively to bilingual children who often develop each of their languages at a different pace, we questioned whether their relative production of unique gestures differs between their stronger and weaker languages. We expected to find an effect of language

dominance on children's production of unique gestures, but found evidence for it. The bilingual children, not surprisingly, knew more words in their stronger language than their weaker language (EOW; $M_{STRONGER}$ = 12.65 vs. M_{WEAKER} = 3.00, $t(33) = 4.99$, $p < .01$), but these differences in expressive vocabulary size did not lead to differences in the production of unique gestures.

One possibility is that the bilingual children were not prone to using more gestures in their weaker language because of language mixing. There is in fact evidence that suggests that young bilingual children frequently borrow words from their dominant language when speaking their weaker language (Field, 2011; Paradis, Nicoladis & Genesee, 2000). The bilingual children in our study were no exception. If a bilingual child in our study did not know the label for an object in one language, they would borrow the word from their stronger language – making them less likely to use gesture to compensate for absent words in their weaker language. In fact, as shown in Table 3 the bilingual children used a substantial number of word types and tokens in their stronger language when interacting in their weaker language.

Another possibility is that the relation of unique gesture use and language proficiency depends on the difficulty of the task. Nicoladis (2007) found the discrepancy in the amount of gestures bilinguals used in their weaker and stronger language to widen as the task became more complex. The bilingual children in our study, in contrast, engaged in a relatively easy task of one-on-one interactions with their parents. Perhaps the children in our study would have shown more pronounced differences in their production of unique gestures in their two languages if the demands of the task were more challenging—a possibility that can be addressed in future work

We next asked whether parents would translate a greater proportion of gestures into speech when interacting in the child's weaker and stronger language, and found no differences in

the rate of parental translations. Prior research has shown that parents of bilingual children provide less rich speech input in the child's weaker language (De Houwer, 2007). In contrast, in our study we found that parents provided similar levels of input (i.e., translations) in both languages when responding to their children's gestures in English and Spanish. One explanation for this could be that bilingual children provided their parents with equal opportunities to respond by producing similar proportions of unique gestures in each of their two languages.

Bilingual children in our study also acquired a greater proportion of their unique gestures as words in subsequent months in their stronger language as opposed to their weaker language. Specifically, English dominant bilingual children in our study made the most gains in their stronger language; in contrast, Spanish dominant bilingual children made similar gains in their stronger and weaker languages. This difference could be explained by changes in language proficiency over time. By age 3;6, the bilingual English dominant children remained English dominant (EOW; $M_{ENGLISH}$ = 37.07 vs. $M_{SPANISH}$ = 5.30, give stats). However, the Bilingual Spanish Dominant children became balanced in both languages (EOW; $M_{ENGLISH}$ = 23 vs. $M_{SPANISH}$ = 23.00, give stats). This is consistent with previous findings showing that English vocabulary scores increase more with age than Spanish vocabulary for English and Spanish dominant bilinguals (Hoff et al., 2012). The observed shift in proficiency is possible due to a change in parent input at home. Prevoo et al. (2011) found that mothers of bilinguals increased their use of the community language as their children started childcare. It is likely that as the bilingual children in our study approached school age, their caregivers increased their use of English in the home, thus contributing to a dominance change for the Bilingual Spanish Dominant children. Consequently, the bilingual children's propensity to produce words for translated gestured items depended on their concurrent language dominance, with more spoken

vocabulary items appearing in English.

Our study shows that gesture plays an important role in bilingual children's vocabulary development—as it does for monolingual children. Bilingual children continue to indicate a substantial number of referents uniquely in gesture even by age 2;6 and parents respond to these gestures, translating them into words—a pattern that remains robust in children's stronger and weaker languages. The targeted parental input to child gesture also plays as important a role for vocabulary development of bilingual children as it does for monolingual children, --with greater rate of translated gesture referents entering children's vocabularies as words.

4.2 Limitations and Future Directions

The children in our study were already past the two-word stage, and were already producing a substantial amount of vocabulary items in speech.. As such, they relied used fewer unique gestures than the younger children that formed to focus of previous work examining effect of parental translations of child gesture on vocabulary development (Dimitrova et al., 2016; Goldin-Meadow et al., 2007). This resulted in fewer opportunities for parents to respond to unique gestures and fewer unique gesture referents that the children acquired in speech than seen in previous work. Future studies examining younger bilinguals who primarily communicate in the gestural modality might shed further light on the effect of parental translations of child gesture on vocabulary development of bilingual children.

The children in our study were also asked to exclusively use English in one interaction and then Spanish in a separate interaction. This might have fostered an artificial linguistic environment that did not conduce a truly naturalistic language sample. In future work, it will be important to include a condition in which no language instruction is given, allowing us to examine whether the patterns we observed in bilingual children's weaker and stronger languages

would remain similar. Furthermore, it will extend the generalizability of these findings if similar studies are conducted with young bilinguals of different language pairs, allowing us to confirm that the observed effect of parental translations is not unique to English-Spanish speaking bilinguals.

Additionally, this study controlled for a variety of factors that are known to influence bilingual vocabulary development such as SES and time of exposure to both languages. However, we did not account for the influence of the majority language the bilingual children experienced in the community outside the home. For example, it would be important to include children's interactions with preschool teachers with whom they spend a large part of their day. It is also possible that the use of the majority language with their teachers in preschool indirectly influences the patterns observed for parental translations. The language children are exposed to in their preschool may become their dominant language, consequently, bilingual children may choose to interact more often in that language at home with their parents, which, in turn could lead to a greater production of unique gestures, parental translations and acquisition of words for gestured items in that language. Future research is necessary to determine whether language use in the classroom or other community settings play a significant role in the effect of parental translations on bilingual children's vocabulary development in each language.

4.3 Implications

The number of children who speak two languages is large and growing (Pew Research, 2013). Often these children are Hispanic, a group that constitutes 17% of the nation's population, designating them as the fastest growing population in America. Alarmingly enough, Hispanics are all statistically at risk for academic failure (Garcia & Jensen, 2009). Despite these statistics, very little research has been done on the gesture and language development in children learning

two languages. As a result, the link between bilingual children's gestures and the parental responses in building children's vocabulary, a significant predictor of academic success (Hart & Risley, 1995), is not understood. This project would have implications for how public policy, teaching and parenting practices can support bilingual children's acquisition of two languages by paying close attention to the gestures their children produce. Understanding the key factors that contribute to later dual language development can help develop more sensitive assessments of children's learning trajectory for more timely input on these concepts, and consequently, more positive learning outcomes both at home and in the classroom.

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APPENDIX: TABLES

Table 1 Summary of Children's Gesture Production

	Monolingual English		Monolingual Spanish		Bilingual English Dominant*		Bilingual Spanish Dominant*	
	Mean (SD)		*Mean (SD)*		*Mean (SD)*		*Mean (SD)*	
All Gesture Tokens	35.65 (19.81)	17	44.53 (27.35)	17	43.85 (24.27)	17	45.97 (23.12)	17
Deictic Gestures	30.00 (17.10)	17	36.65 (27.89)	17	34.97 (23.10)	17	38.26 (22.46)	17
Give Gestures	.41 (.79)	17	.53 (.94)	17	.1.12 (1.07)	17	.76 (.81)	17
Conventional Gestures	4.41 (7.14)	17	5.88 (6.95)	17	7.21 (5.64)	17	5.71 (4.18)	17
Iconic Gestures	.06 (.24)	17	.88 (1.22)	17	.56 (.68)	17	1.24 (.94)	17

Mean: mean raw number, SD: standard deviation, n=number of participants producing a particular gesture (out of 17 per group)

** Bilingual observations were twice as long as the monolinguals; we therefore divided bilingual children's averages by 2, for comparison purposes*

Table 2 Summary for Children's Unique Gesture Production, Translations, and the Emergence of Unique Gestures in Speech

	Monolingual English	Monolingual Spanish	Bilingual English Dominant	Bilingual Spanish Dominant
	Mean (SD)	*Mean (SD)*	*Mean (SD)*	*Mean (SD)*
Unique Gestures	.21 (.18)	.33 (.26)	.31 (.18)	.33 (.20)
Parental Translations	.14 (.19)	.16 (.22)	.17 (.11)	.17 (.15)
Translated Gestures in Speech	.54 (.41)	.44 (.35)	.29 (.18)	.38 (.21)
Non-Translated Gestures in Speech	.40 (.35)	.15 (.19)	.20 (.22)	.22 (.22)

Mean: Mean proportion, SD: standard deviation
**Bilingual observations were twice as long as the monolinguals; we therefore computed proportions, for comparison purposes*

Table 3 Summary for Bilingual Children's Unique Gesture Production, Translations, and the Emergence of Unique Gestures in Speech

	Bilingual English Dominant	Bilingual Spanish Dominant
	Mean (SD)	*Mean (SD)*
Unique Gestures Stronger Language	.28 (.24)	.26 (.16)
Unique Gestures Weaker Language	.40 (.21)	.25 (.17)
Parental Translations Stronger Language	.48 (.26)	.47 (.25)
Parental Translations Weaker Language	.55 (.27)	.45 (.29)
Translated Referents Entering Speech in Stronger Language	.53 (.35)	.34 (.32)
Translated Referents Entering Speech in Weaker Language	.17 (.26)	.37 (.29)

Mean: Mean proportion, SD: standard deviation
**Bilingual observations were twice as long as the monolinguals; we therefore computed proportions, for comparison purposes*

Table 4 Summary for Bilingual Children's English and Spanish Use In their Weaker Language Interaction

	Bilingual English Dominant	Bilingual Spanish Dominant
	Mean (SD)	*Mean (SD)*
English Word Types	76.41 (33.91)	98.2 (40.04)
English Word Tokens	270.94 (148.98)	322.07 (132.12)
Spanish Word Types	72.76 (45.52)	69.73 (42.32)
Spanish Word Tokens	235.24 (128.89)	272.32 (217.32)

Mean: Mean raw number, SD: standard deviation